Chapter 4.0 Environmental Baseline

4.1 Introduction

The environmental baseline describes the impacts of past and ongoing human and natural factors leading to the present status of the species and its habitat within the action area. The environmental baseline provides a "snapshot" of the relevant species' health and habitat at a specified point in time (i.e., the present). The environmental baseline includes past and present impacts of all federal, state, and private actions and other human activities in the action area (50 CFR 402.2). The baseline also includes State, tribal, local, and private actions already affecting the species or habitat in the action area or actions that will occur contemporaneously with the consultation in progress. The environmental baseline assists both the action agency and USFWS and NMFS in determining the effects of the proposed action on the listed species and critical habitat.

4.2 SONCC Coho Salmon

All actions described as part of the environmental baseline have led to the current status of coho salmon in the Rogue River and Klamath River basins. SONCC coho salmon in this ESU experienced significant population declines through the 20th century. A host of adverse human-caused factors, in combination with natural variability in marine and freshwater environmental conditions, essentially impacted all phases of the fishes' life cycle in this ESU working steadily over time to diminish its population numbers from a range of 150,000 to 400,000 naturally spawning fish in the 1940s to about 10,000 fish at the time of the 1997 ESA listing (Federal Register 62:24588).

Watershed streams and riparian areas overall are in relatively poor condition with respect to fish habitat conditions (USFS and BLM 1997). Stream habitat degradation from road building, logging, livestock grazing, mining, irrigation diversion, urbanization, wetlands removal, channelization projects, and point and nonpoint source water pollution impact coho salmon survival in the freshwater setting. The May 6, 1997, Federal Register notice presents summary information on these factors (Federal Register 62:24588).

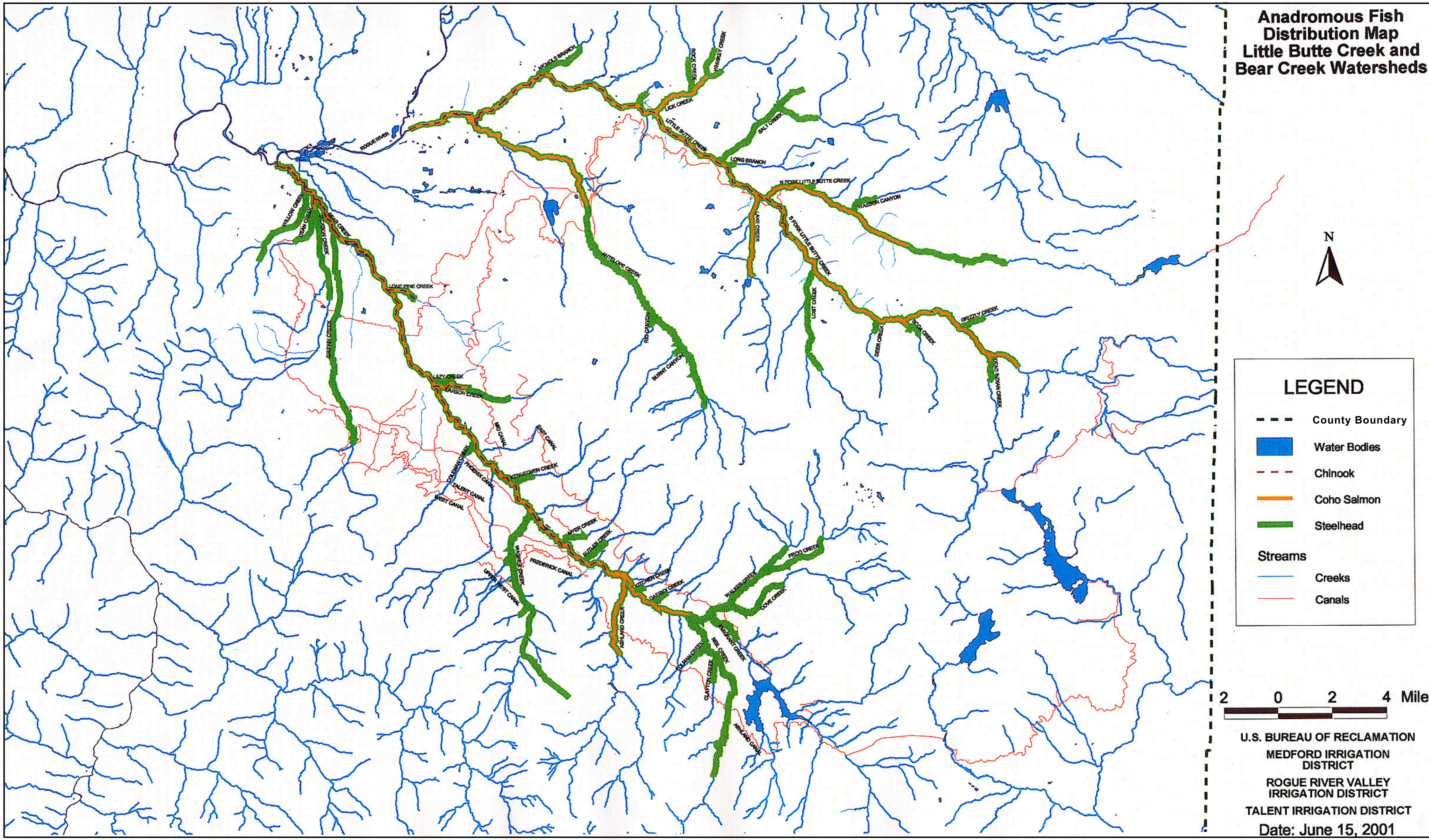
Hatchery and fishery management plus regulatory practices prior to the listing often worked against preservation of wild coho salmon populations.

SONCC coho salmon, along with the region's other salmon and steelhead species, historically supported major commercial and sport fisheries. In hindsight, overfishing of coho salmon was sanctioned from the mid 1970s to the mid 1990s during a time when ocean conditions were poor relative to salmon growth and survival. Commercial and sport overharvesting also contributed to the decline in coho salmon populations.

Coho salmon fisheries during this period consisted of a meager wild fish component mixed with a much more abundant, artificially produced hatchery population of coho salmon. The greater numbers of hatchery fish within these fisheries could not be distinguished from fish produced in nature. This allowed for excessive harvest on declining wild fish stocks. In 1988 this problem was eliminated when Oregon hatcheries began clipping the adipose fin of all released juvenile coho salmon (Jacobs et al. 2000) and restricting harvest of wild fish.

Fluctuating ocean conditions, in particular the Pacific Decadal Oscillation, produced alternating periods of good and poor ocean productivity and environmental conditions that affected survival of anadromous salmonids.

Ocean conditions and cold, nutrient-rich upwelling currents play an important role in overall coho salmon survival. Nutrient-rich water stimulates and enhances phytoplankton and zooplankton production which directly benefits prey animals that coho salmon feed upon. Numerous El Nino climate occurrences in recent decades have depressed upwelling currents resulting in reduced coho salmon growth rates and survival. El Nino-Southern Oscillation events are superimposed over the longer-term Pacific Decadal Oscillation to affect ocean productivity. Droughts and flooding over time added to adverse impacts to naturally occurring anadromous fish runs and caused most wild Pacific Coast coho salmon populations to be listed or considered for listing under the ESA. Rogue River basin streams inhabited by SONCC coho salmon and influenced by Project operations include Little Butte Creek and Bear Creek watersheds (Figure 4-1).



Anadromous Fish Distribution Map Little Butte Creek and Bear Creek Watersheds
N
LEGEND
County Boundary
Water Bodies
Chinook
Coho Salmon
Steelhead
Streams
Creeks
Canals
2 0 2 4 Miles
U.S. BUREAU OF RECLAMATION
MEDFORD IRRIGATION DISTRICT
ROGUE RIVER VALLEY IRRIGATION DISTRICT
TALENT IRRIGATION DISTRICT
Date: June 15, 2001

Figure 4-1

4.2.1 Rogue River Basin

Little Butte Creek Watershed

The Little Butte Creek watershed covers 238,598 acres (about 373 square miles). Bureau of Land Management (BLM) and U.S. Forest Service (USFS) manage about 114,600 acres of Federal land in the basin (48 percent) while most of the remaining (50 percent) is in private ownership. The other 2 percent is owned by the State of Oregon or is within the urban growth boundary of Eagle Point (BLM and USFS 1997). The Little Butte Creek watershed provides some of the best remaining coho salmon production in the Rogue River basin. A total of about 46 miles of known coho salmon spawning and rearing habitat exists in the Little Butte Creek watershed (Vogt 2000). The watershed contains some of the better spawning returns in the entire Rogue River basin and, for the 5 years from 1996 to 2000, this stream averaged 15 coho salmon spawners per mile (Jacobs 2001). This represents the highest average density of coho salmon spawners of all Rogue River basin areas sampled.

The Little Butte Creek surveyed reaches are randomly selected each year so the full range of spawning habitat is represented (Ritchey 2001). Once started, surveys are repeated in select reaches about every 10 days regardless of streamflow conditions. The primary objective is to count spawning coho salmon. Redds are also visually counted. Redds are not flagged, so double counting does occur. Spawned out carcasses are also tallied. This survey approach does not yield a precise estimate of spawner escapement to the stream because only randomly selected stream reaches are inventoried and observations are dependent on water clarity and flow levels. Over a period of years the method provides a relative and valuable indication of coho salmon spawning.

South Fork Little Butte Creek is a designated “coho salmon core area” as identified in the Southwest Oregon Salmon Restoration Initiative (Prevost et al. 1997) and contains about 27 miles of high value stream habitat used by native coho salmon. Coho salmon core areas are streams capable of sustaining year-round coho salmon spawning and rearing. While there may be existing habitat limitations, the resource management intent is to protect and improve these core habitats to help stabilize the basin’s native coho salmon population at a genetically viable level.

Eighteen stream reaches totaling 170.9 miles within Rogue River basin were designated as coho salmon core areas in the Southwest Oregon Salmon Restoration Initiative report (Prevost et al. 1997). This compares to a total of 110 streams and approximately 1,000 miles in the entire Rogue River basin considered to be coho salmon habitat. About 17 percent of Rogue River basin coho salmon streams are considered high value coho salmon core habitat.

Several stream reaches within the Little Butte Creek watershed, similar to other Rogue River basin coho salmon streams, are sampled annually under the ODFW Coastal Salmonid Inventory Project to assess wild adult coho salmon spawning. Sampling occurs in the North Fork, South Fork, Soda Creek, Lake Creek, and Dead Indian Creek drainages of Little Butte Creek. Sampling is done each year during the November to January spawning period (Jacobs et al. 2000). The purpose of these surveys is to gather data to help estimate Rogue River basinwide escapement and correlate the incidence of spawning with habitat conditions and smolt production.

A cooperative ODFW, BLM, and USFS coho salmon and steelhead smolt trapping project started in March 1998 validates that Little Butte Creek is an important producer of wild coho salmon (Vogt 2000). Trapping has been conducted on six upper Rogue River basin streams, including Big Butte Creek, Little Butte Creek (action area stream), West Fork Evans Creek, Slate Creek, South Fork Big Butte Creek, and Little Applegate River.

An irrigation diversion ditch near Eagle Point is fitted with a rotary fish screen, bypass pipe, and collection trap and has been used to capture downstream migrating smolts on Little Butte Creek. Rotary screw traps are used at other stream trapping locations. The sampling period runs from March 1 to June 30 if streamflow permits. Traps are checked daily. Fish are identified as to species and life stage, enumerated, and measured. To estimate trapping efficiency, a subsample of coho salmon over 2.4 inches is marked with a caudal fin clip, transported back upstream, and released. Marked fish are then recaptured to determine trapping efficiency which can be used later to estimate overall coho salmon smolt abundance in the stream. Table 4-1 (all sampled streams) and Table 4-2 (Little Butte Creek) provide upper Rogue River basin coho salmon smolt trapping data collected during 2000 and 2002 plus the corresponding total population estimate for sampled streams (Vogt 2000, Vogt 2002). Little Butte Creek had the second highest estimated coho salmon smolt production of the six streams sampled in 2000. Smolt outmigration peaked in early May at the Little Butte Creek trapping location. Population estimates increased in Little Butte Creek from 11,211 in 2000 to 35,131 in 2002 (Table 4-1 and Table 4-2).

Table 4-1. 2000 Coho Salmon Smolt Production Estimates at Each Trap Site

	Little Butte Creek	Big Butte Creek	West Creek	South Fork Big Creek	Little Creek	Slate Creek
Dates trapped	3/1-6/21	3/1-6/21	3/1-6/7	3/1-6/14	3/1-6/21	3/1-6/1
Number of days trapped	107	110	99	106	109	90
Number of coho salmon captured	3,184	3,381	111	37	8	277
Number of coho salmon marked	1,524	1,954	111	37	8	275
Number of coho salmon recaptured	433	466	3	0	2	27
Trapping efficiency (percent)	28	24	3	0	25	10
Population estimate	11,211	14,206	4,111	NA	32	2,827

Source: Vogt 2000

Table 4-2. 2002 Coho Salmon Smolt Production Estimates at Little Butte Creek

Dates trapped	3/1-6/16
Number of days trapped	108
Number of coho salmon captured	14,228
Number of coho salmon marked	2,186
Number of coho salmon recaptured	885
Trapping efficiency (percent)	41
Population estimate	35,131

Source: Vogt 2002

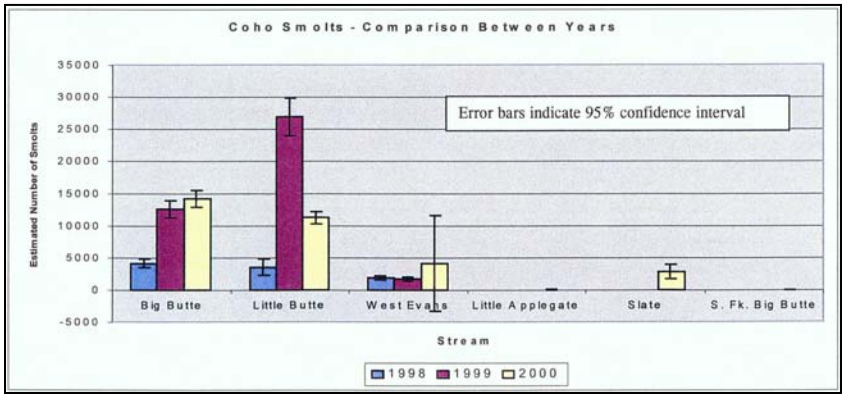


Figure 4-2. Between Year Comparison of Coho Smolt Estimates at Each Trap Site (1998-2000). Source: Vogt 2000

The bar graph in Figure 4-2 illustrates the estimated total smolt production in each of the six streams sampled in 1998-2000.

Stream Habitat Conditions

Much of Little Butte Creek and its tributaries are mostly riffle-dominated, single channeled, and lack historic side-channel and small meadow-wetland-type habitats preferred by coho salmon during juvenile rearing stages. Past management activities in the riparian zones have limited the amount of large wood recruitment (valuable for cover, pool maintenance, and fish rearing), thereby reducing stream shading and streambank stability. Streams lack quality pools, i.e., those with suitable depths and velocities. Reduced riparian vegetation causes streambanks to be less stable. Periodic large storm incidents have taken out streamside riparian vegetation; livestock grazing further impacts it (USFS and BLM 1997).

The Little Butte Creek Watershed Analysis (USFS and BLM 1997) provides extensive information on ecosystem conditions in Little Butte Creek watershed and includes information on stream habitat elements that may affect anadromous fish production.

Water Quality

The watershed currently has water quality limited stream segments on Oregon's Final 2002 303(d) List. These stream segments do not meet certain water quality criteria or support certain beneficial uses.

Oregon scheduled the upper Rogue River Basin Total Maximum Daily Load (TMDL) for completion in 2004. TMDLs determine the maximum allowable level of pollutants a water body can assimilate while supporting existing beneficial uses. TMDLs allocate pollutant loads to different sources in the watershed and set the stage for implementing corrective actions to be taken.

In 2002, ODEQ identified impaired stream segments for the 303(d) list and EPA approved the list on March 24, 2003 (ODEQ 2003). Table 4-3 shows stream segments in Little Butte Creek watershed that are included on the 303(d) list. Other stream segments in the watershed may not meet state water quality criteria but supporting data were not readily available when ODEQ developed the list.

On March 31, 2003, U.S. District Court Judge Ancer Haggerty ordered the EPA to void its earlier approval of Oregon's water temperature standards. Oregon has initiated rulemaking and is working in concert with the ODFW, EPA, NMFS, and USFWS to develop new temperature criteria. For water quality discussions in this BA, Reclamation will use Oregon's existing temperature criteria for comparison purposes.

Table 4-3. Little Butte Creek Watershed 303(d) Listed Waterbody Segments

Waterbody	Listed Segment (RM)	Pollutant
Antelope Creek	RM 0 – 19.7	temperature (summer), *E. coli* (June 1-Sep. 30),
Deer Creek	RM 0 – 3.2	sedimentation
Lake Creek	RM 0 – 7.8	temperature (summer), sedimentation, *E. coli* (year round)
Little Butte Creek	RM 0 – 16.7	temperature (summer), fecal coliform, sedimentation, dissolved oxygen (year round)
North Fork Little Butte Creek	RM 0 – 6.5	temperature (summer), *E. coli* (June 1-Sep. 30),
South Fork Little Butte Creek	RM 0-16.4	temperature (summer), sedimentation
Lost Creek	RM 0 – 8.4	temperature (summer), sedimentation
Soda Creek	RM 0 – 5.6	temperature (summer), sedimentation

Source: Oregon 2003

Temperature

Water temperature data recorded in the Little Butte Creek watershed indicate that several of the segments on the 303(d) list don't meet the water temperature criteria for salmonid rearing during the summer period. The temperature criteria is intended to protect stream rearing cold-water salmonid fish species such as trout, salmon, and steelhead. Temperature data recorded prior to the 2002 303(d) listing show these stream segments routinely had water temperatures above the summer temperature criteria (June 1 to September 30 fish-rearing period). The applicable water temperature target criteria for Little Butte Creek is a 7-day average of daily maximum temperature of 17.8 °C (64 °F) (ODEQ 1998). When conditions do exceed the target criterion, then no measurable increase 0.3 °C (32.5 °F) due to human activities is allowed. More recent sampling confirms the water temperature criterion continues to be unmet in many areas of the Little Butte Creek watershed. This is attributable in part to past practices that have:

- channelized stream segments following flooding events
- removed riparian vegetation thus reducing shading during the summer
- reduced flows during summer months

Summer stream temperatures generally correlate with elevation in the Little Butte Creek watershed; cooler temperatures are found at higher elevations (Figure 4-3). The best summer temperature conditions in the watershed, where temperatures are usually less than 17.8 °C (64 °F), are in stream segments above elevation 4000 feet. These streams are mostly on Federal land in the Little Butte Creek watershed and account for 75 to 85 percent of the viable salmonid production during the summer months (USFS and BLM 1997). However, the amount of this habitat in the watershed available for salmon and steelhead rearing appears to be quite limited. Lower elevation stream sections influenced by cool water spring discharge may provide some localized refugium and good summer rearing temperatures.

Volunteer members of the Little Butte Creek Watershed Council initiated efforts to monitor and collect water quality data (Oyung 1999). The report from the volunteer monitoring program provides monitoring data for locations (high to low elevations, upstream to downstream locations including tributaries) throughout the watershed that record real-time water temperatures (Oyung 2001). During the 1998, 1999, and 2000 summer periods, starting in mid-June through the end of September, all locations except one exceeded the ODEQ 7-day moving maximum temperature criterion of 17.8 °C (64 °F).

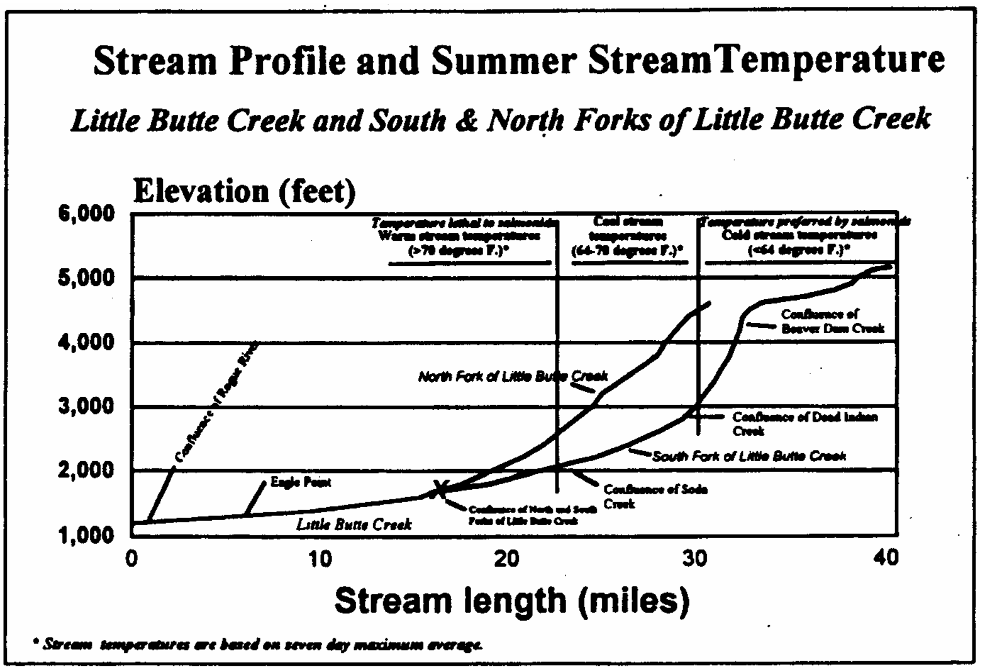


Figure 4-3. Stream Profile and Temperature Conditions in Little Butte Creek Watershed.

Bacteria

Antelope, Lake, North Fork Little Butte, and Little Butte Creeks are on the 303(d) list for exceeding bacteria criterion (fecal coliform or *E. coli*).

Sediment

Storm triggered landslides, both natural and human-caused from older clearcuts and the high number of forest roads, are a continuing source of sediment. Major rain-on-snow storm flood events in 1955, 1964, 1974, and 1997 caused both natural and road/logging related landslides and transported large amounts of sediment into streams of the Little Butte Creek watershed. These storm events caused major stream channel erosion. As a result, a high amount of fine sediment evident in the watershed's lower gradient stream reaches is embedding spawning gravels and filling pools important for juvenile fish rearing.

The 303(d) listing includes stream segments that are water quality limited for sediment. High levels of sediment adversely affect aquatic species by:

- embedding stream gravel and cobble substrates and reducing the quality and quantity of macroinvertebrate habitat
- filling in pools
- diminishing incubating salmonid egg survival by covering eggs and filling in gravel interstitial spaces with fines

Sediment contribution to streams is directly related to streambank stability, road building, and watershed vegetation conditions. The 303(d) listing for sediment was based on ODFW fish habitat surveys showing a high percentage of fine sediments in most of the stream segments.

Water Rights for Instream Flow

Oregon Water Resources Department (OWRD) issued certified water rights to ODFW for instream flow for a number of stream reaches in the Little Butte Creek watershed. ODFW made application for instream rights for reserving flow for anadromous and resident fish migration, spawning, egg incubation, fry emergence, and juvenile rearing.

ODFW used the Oregon Method for its streamflow recommendations to OWRD. The Oregon Method was developed during the 1960s and used as a basis for hundreds of instream flow reservations throughout Oregon. The method is based on field measurements of representative stream reaches that determine the minimum flow necessary to meet depth and velocity criteria for fish passage, spawning, incubation, and rearing activities (Thompson 1972). ODFW recommendations were based on biological requirements of the fish and were not adjusted for seasonal natural or man-caused flow shortages. A more robust instream flow method, such as the Instream Flow Incremental Methodology (Bovee 1982), would account for available water supplies to provide more realistic flow recommendations for different water year types (e.g., wet, average, dry years).

OWRD issued instream flow reservations in consideration of the ODFW requests. However, the resulting instream flow reservations are junior to previously issued water rights for Project and non-Project irrigation water storage and withdrawals and often can’t be met, particularly in the summer and fall periods. Table 4-4 shows seasonal instream flow rights and priority dates as issued by OWRD to ODFW at four locations in the Little Butte Creek watershed. Some instream flow reservations are less than the original ODFW application.

Table 4-4. OWRD-Issued Instream Flow Water Rights for Little Butte Creek System[1] (cfs)

Stream (priority date)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Little Butte Creek at mouth (9/29/69)	120	100	100	100	100	100	100	60	60	20	20	120
Antelope Creek at mouth (9/29/69)	20	25	25	25	25	25	25	10	5	5	5	5 20
North Fork Little Butte Creek at gage 0.6 mile downstream from Fish Lake Dam (5/22/91)	8.72	16.1	16.8	14.3	16.0	19.1	32.4	34.0 20.0	20.0	13.0	13.0	11.3
North Fork Little Butte Creek at mouth (5/22/91)	13.0 18.8	20	20 34	34	34	34	34	34 20	20	13	13	13
South Fork Little Butte Creek at mouth (12/7/90)	23.2	36.6	99.2	120	120	120	120	120 70	70	47	47	38.6

[1]Some months have split instream flow rights: First half of month's flow right is the upper number; second half of month's flow right is the lower number.

Source: USFS and BLM 1997

Bear Creek Watershed

Bear Creek watershed covers 253,440 acres or 396 square miles. USFS and BLM own and manage an estimated 61,700 acres (24.3 percent). These public lands are mostly in the higher elevation headwater areas of the watershed. The entire watershed lies within Jackson County which has a population of about 175,000 people. Most of the county's population resides in the communities of Ashland, Talent, Phoenix, Medford, and Central Point. These communities border the banks of Bear Creek which is the most densely populated and intensely cultivated area in the Rogue River basin (ODEQ 2001).

Fish migrate into and throughout the Bear Creek mainstem and tributaries, and use various habitats. Historically, Bear Creek and its tributaries supported a viable and sustainable fishery for native and anadromous salmonids, including coho salmon; reaching up to the foothills (RVCOG 2001). Early newspapers chronicle fish catches of coho salmon. Habitat quality has declined since settlement from problems associated with decreased water quality, quantity, and instream barriers (RVCOG 2001). The population of coho salmon is significantly reduced from predevelopment levels in Bear Creek.

Coho salmon have historically spawned and reared in the tributaries and mainstem of Bear Creek (RVCOG 2001). Side channels and off-channel habitat (e.g., alcove pools), once abundant, and cooler stream temperatures historically were more conducive to the life-history of coho salmon. These fish must remain in freshwater habitat, generally tributary streams, for one year. Urbanization, agriculture, water withdrawals and loss of stream/floodplain connectivity in the Bear Creek watershed inhibit the recovery of coho salmon (Table 4-5).

Table 4-5. Fishery Status of Bear Creek

Stream	Fish Species: Chinook, Coho, Steelhead, Trout	In-stream Barriers	Major Limiting Factors (Flow, temp, barriers, sediment, habitat quality, connectivity to downstream impacts
Bear Creek Length: 28.8 miles	23 m. Fall Chinook 27 m. Coho 27 m. Sum Stlhd 27 m. Win Stlhd 27 m. Trout	RM 9.5* RM 16* RM 23	Water quality - temperature, agriculture, and urban stormwater run-off increases sediment and reduces water quality. Water flow during summer months reaches lethal temperatures for salmonids, with extremely low flows.

*These are diversion dams operated by TID and RRVID. Fish ladders have been constructed and diversions screened. Fish distribution data provided by Oregon Department of Fish and Wildlife, Bear Creek Distribution Query, November 15, 1999; Limiting factors identified by the Technical Committee.

Coho salmon are now considered almost extirpated from Bear Creek and its tributaries. An occasional live coho salmon or adult carcass may be found during spawning surveys. For instance, only one juvenile coho salmon was captured in 1997 and 1998 during Reclamation's (1999) summer electrofishing surveys in six sections of mainstem Bear Creek (RM 24) and six tributary reaches. Some limited evidence of past coho salmon spawning is noted in Ashland, Larson, and Lone Pine Creeks as indicated on the fish distribution map (Figure 4-1). Summer steelhead and fall Chinook salmon are more abundant and spawning is regularly documented.

Past spawning surveys and smolt production observations during the spring of 2001 (Ritchey 2001) indicate current Bear Creek and tributary flow characteristics appear to favor steelhead and fall Chinook salmon production. Steelhead are apparently better able than coho salmon to ascend and spawn in smaller tributaries where flow and habitat conditions may be somewhat better than in Bear Creek for year-round rearing. The life history of fall Chinook salmon is more adapted to mainstem Bear Creek during the fall months for spawning, springtime fry emergence, and outmigration before water temperatures become warm.

Smolt trapping in 2000-2001 captured between 27 and 100 coho smolts migrating out of Bear Creek, which is considerably below historic production potential (RVCOG 2001). ODFW estimates that coho production is approximately 3.7 coho/mile of habitat in the Bear Creek mainstem (Vogt, 2001). A rotary screw trap was temporarily installed in March 2002 near the confluence of Bear Creek with the Rogue River to collect salmon and steelhead smolts. This trap remained in place until June when flows became too low for effective operation. Only a portion of the downstream migrating fish are collected but, based on a mark-recapture estimate of numbers, overall production can be estimated. Table 4-6 summarizes the total number of downstream migrant salmonids trapped by ODFW in 2002. This indicates some limited coho salmon production is occurring.

Table 4-6. 2002 Coho Salmon Smolt Production Estimates at Bear Creek

Dates trapped	3/1-6/15
Number of days trapped	107
Number of coho salmon captured	68
Number of coho salmon marked	65
Number of coho salmon recaptured	2
Trapping efficiency (percent)	3
Population estimate	2,194

Source: Vogt 2002

Stream Habitat Conditions

Channel conditions and riparian habitat have changed due to human activities such as logging, road building, removal of riparian vegetation, channelization, beaver removal, livestock grazing, irrigation development, land alteration for agricultural, municipal, and residential developments. Connectivity of the riparian habitat has been fragmented; quantity of snags, large woody material, and streambank stability has been reduced. These changes have resulted in increased sediment to streams and reduced stream shading. Low flow conditions in unshaded stream reaches contribute to lower velocities thus increased stream temperatures. Three Bear Creek stream gages provide flow information about the mainstem; however, other stream reaches affected by irrigation water withdrawals and tributary contributions remain unmonitored (BLM 2000).

Water Quality

ODEQ (2001) has conducted water quality monitoring in the Rogue River basin since the mid-1980s and determined Bear Creek watershed is the most impacted watershed in the basin. Poor water quality conditions are the result of a high level of point and nonpoint source pollution related to dense population and urban development, intensive agriculture, and past upper watershed resource management practices. Several stream segments are on the 303(d) list of water quality limited waters (Table 4-7) for not meeting water temperature, bacteria (*E. coli*) or sediment criteria.

TMDLs in Bear Creek watershed were established in 1992 for ammonia, nitrogen, total phosphorus, and biochemical oxygen demand. Some water quality TMDL implementation activities have occurred since then. TMDLs for the Bear Creek water quality limited parameters in Table 4-7 will be developed during 2004.

Temperature

Based on investigations conducted since 1960, ODEQ determined the water temperature criterion for salmonid fish rearing is unmet in many of the 303(d) listed segments, including streams upstream from Emigrant Lake. Oregon state water temperature criterion for salmonid rearing stipulates the 7-day moving average of the daily maximum temperature shall not exceed 17.8 °C (64 °F). This criterion is intended to protect cold water aquatic life such as salmonid fish species.

Bear Creek streams routinely exceed the temperature standard during summer months (June through September), hindering juvenile coho salmon and steelhead survival. Most anadromous fish leave Bear Creek streams by July to enter the Rogue system (RVCOG 2001). Young fall Chinook salmon generally are not affected by summer temperatures because they begin migrating to the ocean shortly after emergence from gravels in the spring. Direct solar radiation on unshaded stream reaches, warm air temperatures, and extended daylight can cause daytime water temperatures to exceed 26.7 °C (80 °F) during the summer (Reclamation 2001b).

Reclamation (2001b) collected water temperature data during the summer and fall of 1998 at three locations on mainstem Bear Creek and at 15 tributary stream sites. Monitoring occurred from August 1 through the end of October to obtain hourly temperature data to monitor diurnal temperature swings and to determine exceedance of the Oregon 17.8 °C (64 °F) criterion. Temperature recorders were installed upstream from irrigated lands on Wagner, Coleman, Griffin, and Jackson Creeks both upstream from irrigated lands and at the confluence with Bear Creek to evaluate the effects of return flows on water temperature.

Table 4-7. Bear Creek Watershed 303(d) Listed Waterbody Segments

Waterbody	Listed Segment (RM)	Pollutant
Upstream from Emigrant Lake		
Carter Creek	RM 0 – 4.8	temperature (summer)
Emigrant Creek	RM 5.6 – 15.4	temperature (summer)
Tyler Creek	RM 0 – 4.0	temperature (summer)
Downstream from Emigrant Lake		
Ashland Creek	RM 0 – 2.8	fecal coliform (year round)
Bear Creek	RM 0 – 26.3	temperature (summer), fecal coliform (year round)
Butler Creek	RM 0 – 5.2	temperature (summer), fecal coliform (winter, spring, fall), dissolved oxygen (year round)
Coleman Creek	RM 0 – 6.9	temperature (summer), fecal coliform (year round), dissolved oxygen (year round)
Crooked Creek	RM 0 – 4.3	fecal coliform (year round)
Emigrant Creek	RM 0 – 3.6	temperature (summer)
Griffin Creek	RM 0 – 14.4	temperature (year round), fecal coliform (year round)
Jackson Creek	RM 0 – 12.6	temperature (year round), fecal coliform (year round)
Larson Creek	RM 0 – 6.7	temperature (summer), dissolved oxygen (Oct 1-May 31), pH (year round), fecal coliform (year round)
Lazy Creek	RM 0 – 4.5	temperature (summer), fecal coliform (year round), pH (Oct 1-May 31)
Lone Pine Creek	RM 0	temperature (summer)
Meyer Creek	RM 0 – 5.3	temperature (summer), fecal coliform (year round)
Neil Creek	RM 0 – 11.4	temperature (year round), dissolved oxygen (year round)
Payne Creek	RM 0 – 2.1	temperature (summer), fecal coliform (year round), dissolved oxygen (year round)
Wagner Creek	RM 0 – 7.4	temperature (summer)
Walker Creek	RM 0 – 6.7	temperature (Oct 1- May 31)

Source: ODEQ 2003

Monitoring results showed the three Bear Creek sites exceeded the temperature standard into late September with the highest daily diurnal fluctuation of -12.8 °C (9 °F). The highest daily diurnal fluctuation in temperature on Bear Creek tributaries was -11.7 °C (11 °F) with the 17.8 °C (64 °F) criterion exceeded for extended time periods at all monitored sites. Some tributaries with two monitoring sites (Wagner and Coleman Creeks) had water temperature increases from the upper to lower sites and visa-versa (Griffin Creek) during some time periods. Jackson Creek showed very little change in temperature from the upper to lower site.

Climatic variables, air temperature, solar radiation, humidity, and the time of year have the greatest effect on Bear Creek water temperature. Tributary irrigation surface return flows may also have an effect on water temperature.

Ashland's wastewater treatment plant is the only major permitted point discharger directly into Bear Creek. This facility has been a major source of nutrient loading (about 80 percent of Bear Creek's nutrient loading) and warm water temperatures to Ashland Creek and Bear Creek (Reclamation 2001b). The city of Ashland completed an upgrade to its waste treatment facilities to bring nutrient discharges within ODEQ standards. Work on decreasing warm water discharges is pending (Ellis 2003).

Bacteria

About half of the 303(d) listed stream segments exceed standards for bacteria (fecal coliform). Bacteria sources in the highly developed Bear Creek watershed are likely attributable to cross connections between sanitary and storm sewer systems, certain permitted industrial sites, animal waste on ground surfaces (birds and livestock), illegal dumping into storm sewer systems, and general urban and rural runoff (ODEQ 2001). High bacteria levels impact beneficial uses associated with aesthetic quality and water-contact recreation.

Sediment

Agricultural water users on about 43 percent of the acreage have changed their water application methods from flood to sprinkler or drip irrigation over the last 25 years (Reclamation 2001b). These changes lowered the amount of irrigation surface runoff and subsurface return flow and sediment loading to Bear Creek.

Water Rights for Instream Flows

OWRD issued several certified instream flow water rights during 1996 to ODFW for Bear Creek tributaries including Emigrant, Walker, Wagner, and Griffin Creeks. ODFW also applied for monthly instream flow reservations for mainstem Bear Creek.

OWRD based the instream rights on estimated remaining unappropriated natural flow rather than on ODFW's originally petitioned seasonal flow which was based on biological fishery requirements derived from the Oregon Method.

Considerable debate took place as to whether Bear Creek ever naturally flowed at some of the monthly levels ODFW requested. OWRD (1966) estimated average natural (sometimes referred to as historic) flows at Bear Creek mouth, which provided a basis to compare current flows (see Table 4-8). OWRD subsequently proposed reduced instream flow based on prior water rights issued and the available amount of remaining unappropriated water. These rights are junior to previously issued consumptive rights and ODFW requested flows couldn't be met during the summer and fall periods because of senior irrigation diversion rights. OWRD never issued a final certification order for Bear Creek instream flow reservations. Table 4-9 lists final and proposed OWRD instream flow reservations for stream reaches in Bear Creek watershed.

Table 4-8. Natural and Current Water Flows in Bear Creek, and Instream Water Rights

	Estimated Natural (Historic) Flow	Current Flow Medford Gage[1]
January	216 cfs	221 cfs
February	265 cfs	223 cfs
March	241 cfs	202 cfs
April	182 cfs	197 cfs
May	168 cfs	134 cfs
June	101 cfs	73 cfs
July	40 cfs	29 cfs
August	24 cfs	29 cfs
September	20 cfs	31 cfs
October	24 cfs	33 cfs
November	62 cfs	59 cfs
December	153 cfs	147 cfs

[1]Average Monthly Discharge in cfs. Bear Creek at Medford (Mile 11.0). Period of record 1921-1981 Station 14357500.

Table 4-9. Bear Creek Watershed Instream Flow Rights (cfs)

OWRD-Issued Water Rights												
Stream	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May[1]	Jun	Jul	Aug	Sep
Emigrant Creek (downstream from dam)	6	13	27	38	48	46	37	38	22	9	6	5
Walker Creek (Cove Creek to mouth)	7	13	16	27	27	27	27	27 16	16	11	7	6
Wagner Creek (Basin Creek to mouth)	2	5	11	16	19	19	15	15	9	3	2	2
Griffin Creek (Hartley Creek to mouth)	0.5	2	7	10	13	11	7	5	3	1	0.5	0.4
OWRD Proposed Instream Flow Rights[2]												
Bear Creek (Walker Creek to mouth)	24	62	153	170	170	170	170	168 170	100	40	24	20

[1]Walker Creek and Bear Creek have split May instream flow. The top number applies to the first half of the month; the bottom number applies to the second half.

[2]An August 20,1996, draft OWRD certificate notice identified these instream flow rights. A final certificate was never issued.

4.2.2 Fish Passage

The Rogue Basin Fish Access Team (RBFAT) extensively surveyed the Rogue River basin to identify locations of juvenile and adult fish barriers. RBFAT is comprised of representatives from numerous State and Federal agencies and other groups that developed a plan and process to improve fish passage throughout the basin (RBFAT 2000). This plan includes description, classification and prioritization of barriers, a barrier removal prioritization process, treatment alternatives, project funding options, and other information.

RBFAT inventoried over 830 individual Rogue River basin fish barrier sites to date. These consist of pushup dams, concrete diversion dams, culverts, bridges, and other obstructions (Mason 2001). The inventory does not include irrigation pumping locations.

Little Butte Creek Watershed

The RBFAT inventory identified 60 fish barrier locations specific to the Little Butte Creek watershed. Fifty-nine of these were associated with privately owned facilities. These locations include 24 pushup dams that can require annual instream reconstruction; 12 permanent, mostly concrete-type, diversion dams; and 24 road culverts that impact fish passage. ODFW determined most of the diversion dams impede fish passage and many of the road culverts are absolute barriers under all flow conditions (RBFAT 2000). A large number of small streamside irrigation pumps of non-Project private water users are believed to be on streams and tributaries throughout the Little Butte Creek watershed. The RBFAT inventory excludes these pump withdrawal locations. The screening status of these locations is unknown.

The Little Butte Creek Watershed Council has been instrumental in securing landowner support and funding from Oregon Watershed Enhancement Board and USFWS to upgrade fish passage protection at several private diversion dams (Anthony 2001). These efforts have permanently removed several pushup dams and initiated other projects that will structurally correct adult and juvenile fish passage deficiencies. Knuteson (2001) provided technical design assistance on some of these projects (Hanley North, Hanley South, and Guill diversions). State of Oregon requires irrigation diversions to include installation of working fish screens. ODFW works cooperatively with landowners and administers a cost-share program whereby the diverter pays only 40 percent of the screening cost.

Federal Facilities

Antelope Creek Diversion Dam is a federally-owned facility operated by RRVID. Reclamation improved adult fish passage and fish screens at RRVID's Antelope Creek Diversion Dam in 1997 and 1998. The new fish screen system gives ODFW the ability to trap, collect, and haul downstream migrant smolts when streamflow is too low to provide adequate bypass flow back to Antelope Creek. RRVID operates and maintains the Reclamation-owned diversion facility.

Reclamation constructed six diversion dam structures in the head water tributaries of South Fork Little Butte Creek watershed. These structures are located upstream from a natural waterfall which blocks fish passage (USFS and BLM 1997). The facilities are South Fork Little Butte Creek Diversion Dam, Daley Creek Diversion Dam, Beaver Creek Diversion Dam, Dead Indian Diversion Dam, Pole Bridge Diversion Dam, and Conde Creek Diversion Dam. Reclamation constructed these facilities to collect water for conveyance across the Cascade Divide for storage in Howard Prairie

Lake. TID operates and maintains these diversion facilities. These diversion dams don't block fish passage and are not discussed further in the BA.

Non-Federal Facilities

MID and RRVID own, operate, and maintain North Fork and lower South Fork Little Butte Creek Diversion Dams. The diversion dams are each about one-half mile upstream from the confluence of the North Fork and South Fork Little Butte Creek.

A new fish screen was installed on the South Fork Little Butte Creek in April 2003. The fish ladder, also at this site, is scheduled to be replaced summer 2003 during low flows.

The fish screen and ladder for the North Fork Little Butte Creek do not meet present day standards. Grant money was awarded for 2003, construction is scheduled to begin in fall 2003.

RRVID and MID canals traverse some anadromous fish-bearing streams in the Little Butte Creek watershed. However, all such crossings use flume or siphon structures and pose no fish passage impediments. No water is withdrawn from these streams, except at Antelope Creek Diversion Dam, to augment canal flow. Table 4-10 provides information on these canal crossings relative to fish passage.

Other private diversion dam structures exist in South Fork Little Butte Creek watershed. Many fish screen facilities still do not meet present day fish protection design standards. The ODFW inventory in the Little Butte Creek watershed indicates 16 operating fish screen installations meet current fish passage protection criteria while 18 are inadequate (Kilbane 2001).

Bear Creek Watershed

RBFAT identified a large number of physical fish passage barriers located throughout the Bear Creek watershed. The RBFAT program prioritizes fish passage funding and improvement projects. Table 4-11 provides a general tally of fish passage barriers identified to date. The RBFAT (2000) inventory lists 119 fish passage barriers in tributaries entering Bear Creek downstream from Emigrant Dam. Road culverts and bridge crossings comprise 108 of these. ODFW judged most of these to be either total fish passage barriers under all flow conditions or to be a passage impediment under most flows. The remaining 11 barriers are mostly non-Federal permanent concrete diversion structures.

Table 4-10. Rogue River Basin Project Canal Crossings of Anadromous Fish-Bearing Streams in Little Butte Creek Watershed

Creek Crossed (Fish Species)	Canal Mile	Type of Crossing	Wasteway at Crossing?	Possible Creek Diversions to Canal?	Is Fish Passage Protection Provided at Diversion?
Creeks crossed by RRVID's Hopkins Canal (diversion from Joint System Canal at Bradshaw Drop, canal mile 17.0)					
Yankee Creek (steelhead)	2.70	flume	no	no	RRVID does not divert water from Yankee Creek.
Antelope Creek (steelhead, coho salmon)	3.40	siphon	yes	yes	RRVID's Antelope Creek Diversion Dam is screened and laddered; Antelope Creek has no other RRVID diversions.
Creeks crossed by MID's Joint System Canal and used by RRVID (diversions from North Fork Little Butte Creek at RM 0.8 and South Fork Little Butte Creek at RM 17.9)[1]					
Lake Creek (steelhead, coho salmon)	1.47	siphon	no	no	MID has no diversions from Lake Creek.
Creeks crossed by MID's Medford Canal (diversion from Joint System Canal at Bradshaw Drop, canal mile 17.0)[1]					
Yankee Creek (steelhead)	3.06	siphon	yes	no	MID has no diversions from Yankee Creek.
Antelope Creek (steelhead, coho salmon)	4.90	siphon	yes	no	MID has no diversions from Antelope Creek

[1] Private facilities which are not part of the proposed action

The RBFAT list excludes streamside pump locations that have the potential to dewater the stream and entrain juvenile salmonids if not properly screened. Existing screen systems on pump intakes and gravity surface diversions in fish-bearing streams often don't meet current fish passage protection criteria or may not exist. The inventory is not necessarily complete and does not include all the fish passage barrier locations (categories listed above) on Bear Creek tributaries (Ritchey 2001).

Table 4-11. RBFAT-Inventoried Bear Creek Fish Passage Barriers Downstream from Emigrant Dam

Barrier Type	Mainstem Bear Creek	Bear Creek Tributaries
Diversion dams: Project permanent structures (Oak Street, Phoenix, and Jackson Street)	3 (all meet current NMFS passage criteria)	10 (6 meet current NMFS passage criteria)
Pushup dams	none	1 (does not meet current NMFS passage criteria)
Road culverts/bridges	none	108
Streamside pumps	not documented	not documented
Total RBFAT barriers	3	119

Source: RBFAT 2000

Sixteen tributaries considered to be fish-bearing streams for salmon and steelhead enter Bear Creek. These streams, plus a few of their respective smaller tributaries, are documented locations for anadromous fish migration, spawning, and rearing (Figure 4-1). Fish passage impediments related to road and highway crossings, urban and rural land uses, and water withdrawal systems are found within all these streams.

Many undocumented locations likely exist where water is diverted from the 16 tributaries into ditches or through pump intakes. Fish passage protection at these locations may be lacking or many diversions could be upstream from fish migration blockages in lower reaches of the stream. Water users divert from these streams and share in fish passage problems.

Federal Facilities

Emigrant Dam, 29 miles upstream from the mouth of Bear Creek on Emigrant Creek, was first built in 1924 and enlarged as part of the authorized Project in 1960. The dam has no fish passage facilities.

Two Federal diversion dams are on mainstem Bear Creek downstream from Emigrant Dam. Oak Street Diversion Dam (RM 21.6) and Phoenix Canal Diversion Dam (RM 16.8). Reclamation and irrigation districts were involved in funding, designing, and making extensive modifications to these diversions and their fish passage facilities from 1997 to 1999 under the Rogue River Basin Fish Passage Improvement Program. This work upgraded fish passage protection at the diversions to the latest NMFS criteria for fish ladders, fish screens, and juvenile bypass systems.

New adult fish ladders were constructed at the dams and older fish screens in the canal were replaced with state-of-the-art rotary drum or self-cleaning vertical screens. Juvenile fish bypass systems were also included in the modifications. Adult fish passage has improved since the fish passage modifications were made at these structures (Ritchey 2001). More fall Chinook salmon spawners were noted in Bear Creek upstream from Oak Street Diversion Dam in the fall of 2000 than in any of the previous six years that redd counts were conducted in Bear Creek (Hutchins 2001).

Some canal crossings on Bear Creek tributaries may impede or block upstream migration. However, most canal crossings are now by buried siphon or overhead flume.

Non-Federal Facilities

Jackson Street Diversion Dam (RM 9.6) is a non-Federal diversion dam on Bear Creek downstream from Emigrant Dam. Hopkins Canal Diversion Dam was dismantled and completely replaced one-quarter mile upstream by Jackson Street Diversion Dam. Reclamation and irrigation districts were involved in funding, designing, and making extensive modifications to the diversion dam and its fish passage facilities from 1997 to 1999 under the Rogue River Basin Fish Passage Improvement Program. This work upgraded fish passage protection at the diversion to the latest NMFS criteria for fish ladders, fish screens, and juvenile bypass systems.

New adult fish ladders were constructed and older fish screens in the canal were replaced with state-of-the-art rotary drum or self-cleaning vertical screens. Juvenile fish bypass systems were also included in the modifications. Adult fish passage in Bear Creek has improved since the fish passage modifications were made (Ritchey 2001).

Medford and Phoenix Canals cross fish-bearing streams by using concrete dam structures with check boards that can be removed after the irrigation season. Some of the crossings can spill canal water to the natural stream course for conveyance to downslope water users. Creeks where irrigation districts retain natural flow rights can be diverted to the canal. Table 4-12, Table 4-13, and Table 4-14 provide the type of crossing, creek diversions to the canal, existing fish passage protection, and diversions from the canal (wasteway) for TID, MID, and RRVID canal crossings on fish-bearing Bear Creek tributaries.

Table 4-12. TID Canal Crossings and Diversions from Anadromous Fish-Bearing Streams in Bear Creek Watershed

Creek Crossed (Fish Species)	Canal Mile	Type of Crossing	Wasteway at Crossing?	Possible Creek Diversions to Canal?	Fish Passage Protection Provided at Stream Diversions?
Ashland Canal - Diversion From Emigrant Creek at Ashland Canal Diversion Dam (RM 33.7)					
Neil Creek (steelhead, coho salmon)	9.78	siphon	yes	yes	TID's canal diversion is screened and will be laddered in 2004; no other TID diversions at Neil Creek
Clayton Creek (steelhead)	11.0	siphon	yes	no	No TID diversion on Clayton Creek
Tolman Creek (steelhead, coho salmon)	13.68	siphon	yes	no	1 TID diversion on Tolman Creek without fish passage protection
Hamilton Creek (steelhead, coho salmon)	13.95	siphon	No	no	2 TID diversions on Hamilton Creek without fish passage protection
East Canal - Diversion From Emigrant Lake Outlet Channel (RM 29.2)					
Cove and Walker Creeks (steelhead)	4.06	siphon	No	no	No TID diversion on Cove and Walker Creeks
Gaerky Creek (steelhead)	7.06	siphon	yes	no	No TID diversion on Gaerky Creek
Kitchen Creek (steelhead)	8.20	siphon	yes	no	No TID diversion on Kitchen Creek
	11.85	Diversion to West Canal and Billings Wasteway to Bear Creek (3,200 feet of 18-inch pipe)			
Butler Creek (steelhead)	12.81	siphon	yes	no	1 TID diversion on Butler Creek without fish passage protection
Meyer Creek (steelhead)	13.72	siphon	yes	no	3 TID diversions on Meyer Creek without fish passage protection
Kentuchen Creek (steelhead)	18.08	siphon	yes	no	No TID diversion on Kentuchen Creek
Larson Creek (steelhead)	24.65	siphon	yes	no	1 TID diversion on Larson Creek below canal crossing

Creek Crossed (Fish Species)	Canal Mile	Type of Crossing	Wasteway at Crossing?	Possible Creek Diversions to Canal?	Fish Passage Protection Provided at Stream Diversions?
West Canal – Diversion From East Canal (Canal Mile 11.85)					
Lower Wagner Creek (steelhead) [1]	4.90	siphon	yes	yes	Creek diversion to West Canal is fitted with fish ladder and screen.
Coleman Creek (steelhead)	10.23	siphon	yes	no	1 TID diversion downstream from West Canal siphon crossing of Coleman Creek. Without fish passage protection.
Griffin Creek (steelhead)	17.95	siphon	yes	no	1 TID diversion from Griffin Creek. Without fish passage protection.
Talent Canal –Diversion From Bear Creek at Oak Street Diversion Dam (RM 21.6)					
Butler Creek (steelhead)	1.99	siphon	yes	no	No TID diversion from Butler Creek
Bear Creek (steelhead, coho salmon, fall Chinook salmon)	2.63	siphon	No	no	Buried Talent Canal siphon under Bear Creek does not impede fish passage
Coleman Creek (steelhead)	9.92	siphon	yes	no	2 TID diversions on Coleman Creek without fish passage protection
Griffin Creek (steelhead)	18.99	siphon	yes	yes	No diversion from Griffin Creek downstream from canal crossing.
	22.37	End of lateral. Excess flow enters natural drainage to Phoenix Canal.			

Table 4-13. MID Canal Crossings and Diversions from Anadromous Fish-Bearing Streams in Bear Creek Watershed

Creek Crossed (Fish Species)	Canal Mile	Type of Crossing	Wasteway at Crossing?	Possible Creek Diversions to Canal?	Fish Passage Protection Provided at Stream Diversions?
Medford Canal - Diversion from Joint System Canal at Bradshaw Drop (Canal Mile 17.0)[1]					
Lazy Creek (steelhead)	23.14	diversion check dam across creek	yes	yes	Upstream and downstream fish passage is blocked when the dam's check boards are in place. No other downstream MID diversions exist from Lazy Creek.
Larson Creek (steelhead)	25.17	diversion check dam across creek	yes	yes	Upstream and downstream fish passage is blocked when the dam's check boards are in place. No other downstream MID diversions exist from Larson Creek.
Bear Creek (coho salmon, steelhead, fall Chinook salmon)	29.4	siphon	yes	End of Medford Canal siphon discharges into Phoenix Canal	
Phoenix Canal – Diversion From Bear Creek at Phoenix Canal Diversion Dam (RM 16.8)					
Bear Creek (coho salmon, steelhead, fall Chinook salmon)	NA	Phoenix Canal Diversion Dam is laddered and screened.			
Coleman Creek (steelhead)	3.09	diversion check dam across creek	yes	yes	Upstream and downstream fish passage is blocked when the dam's check boards are in place. No other downstream MID diversions exist from Coleman Creek
Griffin Creek (steelhead)	9.15	diversion check dam across creek	yes	yes	Upstream and downstream fish passage is blocked when the dam's check boards are in place. 2 downstream MID diversions on Griffin Creek without fish passage protection.
Jackson Creek (steelhead)	12.23	siphon	yes	no	

[1] Private facility which is not part of proposed action

Table 4-14. RRVID Canal Crossings and Diversions from Anadromous Fish-Bearing Streams in Bear Creek Watershed

Creek Crossed (Fish Species)	Canal Mile	Type of Crossing	Wasteway at Crossing?	Possible Creek Diversions to Canal?	Fish Passage Protection Provided at Stream Diversions?
Hopkins Canal - Diversions From Bear Creek at Jackson Street Diversion Dam (RM 9.5)					
Bear Creek (coho salmon, steelhead, fall Chinook salmon)	NA	siphon	yes	yes	Jackson Street Diversion Dam is laddered and screened
Griffin Creek (steelhead)	3.65	flume	yes	yes, but diversion is no longer used	1 RRVID diversion on Griffin Creek downstream from canal crossing without fish passage protection
Jackson Creek (steelhead)	4.10	flume	yes	yes, possible by pump but diversion is no longer used	2 RRVID diversions from Jackson Creek downstream from flume without fish passage protection
Dean Creek (steelhead)	7.66	flume	yes	no	1 RRVID diversion on Dean Creek without fish passage protection
Willow Creek (steelhead)	8.17	End of lateral. Water spills to Willow Creek for delivery to downstream water users. No RRVID diversion facilities are on Willow Creek.			

A private dam located about one-half mile downstream from Emigrant Dam on Emigrant Creek is a blockage to upstream salmon migration. However, coho salmon probably do not spawn in this reach (Ritchey 2001).

Mainstem Bear Creek may have a number of small private, pump diversions along the stream. It is unknown whether the pump intakes are screened. Other fish passage barriers include road culverts and bridge crossings, and an undocumented number of small irrigation water diversion structures or pumps on Bear Creek tributaries.

A fish screening cost-share program with the State of Oregon is available to those with water rights issued prior to 1989 (Kilbane 2001). Rogue Valley Council of Governments staff walked the lengths of Bear Creek tributaries a few years ago identifying water withdrawal locations by using GPS and digital camera equipment. Data and results from this inventory, however, have yet to be compiled and reported.

4.2.3 Klamath River Basin

All actions described as part of the environmental baseline have led to the current status of coho salmon in the Klamath River basin. Coho salmon are restricted to the mainstem Klamath River and tributaries below Iron Gate Dam. No passage facilities exist at Iron Gate or Copco dams, which are owned and operated by PacifiCorp. Available recent information suggests adult populations are small to nonexistent in some years. Existing information also indicates that adult coho salmon are present in the Klamath River as early as September and juvenile coho salmon are present in the mainstem Klamath River year round.

The Klamath River basin coho salmon discussion is taken from Reclamation’s 2002 Klamath Project BA (Reclamation 2002).

The historic range of coho salmon in the Klamath River basin is illustrated in Figure 4-4. Historic salmon habitat in the Upper Klamath River basin was blocked as early as 1889 at Klamathon near Iron Gate (KRBFTF 1991). Beginning in 1910, the Federal Bureau of Fisheries installed a fish rack to capture salmon eggs, leaving little chance for passage of upstream migrants after that time. In 1917, the construction of Copco Dam formed a complete block to upstream migration and the loss of over 75 miles of habitat in the Klamath River plus tributaries as far upstream as above Upper Klamath Lake.

Mining activities within the Klamath basin began before 1900 (KRBFTF 1991). Water was diverted and pumped for use in sluicing and hydraulic mining operations. This resulted in dramatic increases in silt levels altering stream morphology and degrading spawning and rearing areas. The mining activities may have had a greater negative impact to the salmon fishery than the large fish canneries of the era. Since the 1970s, mining operations have been curtailed due to stricter environmental regulations. However, mining operations in some of the Klamath River tributaries continue, including suction dredging, placer mining, gravel mining, and lode mining. These operations can adversely affect spawning gravels, decrease survival of eggs and juvenile fish, decrease the abundance of bottom food organisms, adversely affect water quality, and impact stream banks and channels.

Roads associated with timber harvesting and timber management activities have contributed to erosion and increases in sedimentation in streams causing degradation of spawning gravels, pool filling, reduced aquatic insect abundance, and changes in channel structure and habitat diversity.

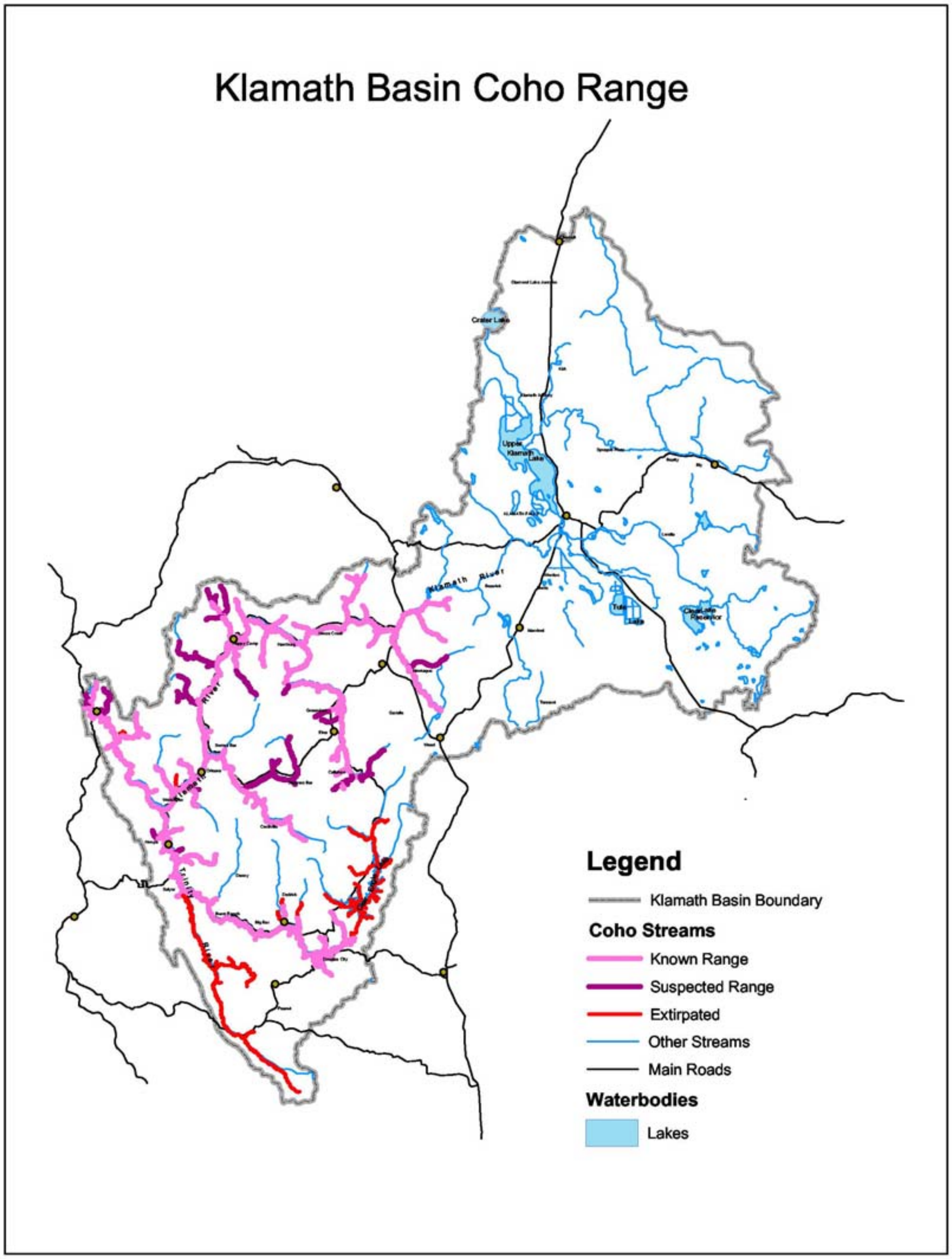


Figure 4-4. Historical range of coho salmon in the Klamath River Basin. Source: Reichert 2003.

Klamath River Mainstem

Beginning in the late 1800s, construction and operation of the numerous non-Project facilities and, beginning in 1906, Klamath Project facilities have changed the natural hydrographs of the mainstem Klamath River (Reclamation 2001c). Major Project diversion facilities include the A-Canal, Link River Dam, Lost River Diversion Dam, and the Lost River Diversion Channel. Non-Project facilities include Copco Nos. 1 and 2 Dams, J.C. Boyle Hydroelectric Dam, Iron Gate Dam and Keno Dam. Changes in the flow regime at Keno, Oregon, after the construction of the A-Canal, Link River Dam, and the Lost River Diversion Dam, can be seen in the 1930-to-present flow records. These changes have reduced average flows in summer months and altered the natural seasonal variation of flows to meet peak power and diversion demands (Hecht and Kamman 1996). Flows downstream from Iron Gate Dam affect the quantity and quality of aquatic habitat for coho salmon in the mainstem Klamath River in California.

Iron Gate Dam, located approximately at RM 190 on the mainstem Klamath River, was completed in 1962 and is owned and operated by PacifiCorp. Iron Gate Dam was constructed to re-regulate flow releases from the Copco facilities, but it did not restore the preproject hydrograph. Minimum stream flows and ramping rate regimes were established in the FERC license covering operation of Iron Gate Dam. A fish hatchery was constructed by PacifiCorp as a mitigation measure for the loss of fish habitat between Iron Gate and Copco No. 2 Dams.

Klamath River Tributaries

Klamath River tributaries downstream from Iron Gate Dam provide habitat critical for coho salmon. Jenny Creek is located upstream of Iron Gate Dam and is not accessible to coho salmon. Most coho spawning occurs in the tributary streams rather than in the mainstem of Klamath River. The mainstem serves primarily as a migratory pathway. Coho move into the tributaries with the onset of fall rains and increased flows. Suitable tributary flows are important to provide coho access to spawning habitat during their upstream migrations. Many coho attempt to migrate as far upstream as possible and then hold in deep pools near good spawning sites until they are ready to spawn a month or more after freshwater entry. Redds (spawning sites) must remain watered throughout the incubation period. After they emerge from the gravel in the spring the young fish disperse into the available habitat. During the year that juvenile coho spend in freshwater they utilize pools with good cover and cool water, which are predominantly in the tributaries. Cool water is critical for survival during the warm summer period. Many coho likely move downstream from the spawning location because coho generally spawn near the upstream extent of good rearing habitat. It is unlikely that significant numbers of coho enter the mainstem Klamath for summer rearing because tributary water temperatures are cooler. During winter when water temperature is below about 10 °C (50 °F) and high flows are more frequent, juvenile coho seek denser cover and lower water velocity than used during the summer. These conditions are often found in off-channel areas of the tributaries.

Outside of the Klamath Project, many Klamath River tributaries have been modified significantly, which affected coho populations. The natural hydrograph has been modified by water diversions in major tributaries such as the Shasta River, Scott River, Trinity River, Cottonwood Creek, and Bogus Creek. Many of the steeper watersheds have experienced substantial road building and timber harvest. Mining occurred historically and continues within active channels mostly in the form of small one or two person operations using portable dredges in areas such as the Scott River.

Agricultural diversions from major Klamath tributaries downstream of the project have resulted in summer flow conditions that eliminate a significant amount of juvenile rearing habitat. Agricultural diversions typically start during the spring and continue into the fall. During most years, spring flows are sufficient to maintain fish habitat and support the diversions. Coho generally rear near the area that they were spawned. When diversions begin in the spring of dry years, stream flow drops substantially and can strand fry or outmigrating smolts. As the summer progresses, and natural flows decrease, the diversions take a majority of the net flow. The coho downstream of diversions get forced into smaller habitat areas, water temperature increases with the lower water volume, and predation by other fish and terrestrial predators increases. The result is a much lowered survival of juvenile coho through the summer and fall period. While many diversions have been screened in recent years, there remain many unscreened diversions. Some coho rearing near the diversion points get diverted into agricultural fields or may get drawn into pumps and killed. During many years, the flows required to maintain fishery values and support heavy agricultural diversions simply are not in the system during the latter part of July, August, and September. Many streams would have critically low flow levels during this time even if no water were diverted.

During the fall when adult coho salmon begin their upstream migrations, flows from the tributaries are critical for providing access to the spawning areas in the tributaries. During dry years, such as occurred in 2001, flows in tributaries can be too low for adults to enter the rivers. They are then forced to hold in the mainstem Klamath River until flows increase enough to allow for upstream migration. Some tributaries contain difficult passage areas where low flows cause partial or total barriers to upstream migration. If coho are held back by low flows until ready to spawn they can spawn in areas lower in the watershed, but the amount of habitat available to the juveniles is then restricted to the lower reaches of the rivers. Diversion dams exist in some tributaries and impede upstream access by juveniles and adults.

Water Quality

In addition to hydrologic changes caused by the activities discussed above, human activities have resulted in degraded water quality in the Klamath River basin. The main water quality problem for coho is high water temperature. The Klamath River, from source to mouth, is listed as water quality impaired (by both Oregon and California) under Section 303(d) of the Federal Clean Water Act (CWA). In 1992, the California State Water Resources Control Board proposed that the Klamath River be listed under the CWA as impaired for both temperature and nutrients, requiring the development of TMDL limits and implementation plans. The EPA and the North Coast Regional Water Quality Control Board accepted this action in 1993. The basis for listing the Klamath River as impaired was aquatic habitat degradation due to excessively warm summer water temperatures and algae blooms associated with high nutrient loads, water impoundments, and agricultural water diversions (EPA 1993). However, the Klamath River has probably always been a relatively warm river (Hecht and Kamman 1996).

Tributary influences to the Klamath River mainstem temperatures are seasonally important (Deas and Orlob 1999). During the spring, certain tributaries contribute significant inflow to the mainstem. By mid- to late spring, the tributary flow drops in response to irrigation demand, and tributary contributions to the mainstem are minor. In the summer and early fall, tributary flows are small relative to the mainstem flow. Locally, these tributaries may have an impact, but generally, they provide minor contribution to the water temperature of the system (Deas and Orlob 1999). Generally tributary water is cooler than the mainstem, and the tributary flows are much lower than the mainstem such that the higher mainstem flows mask the temperature benefits from the tributaries. The termination of irrigation in late fall results in increased inflow from major tributaries. These tributaries have small thermal mass relative to the Klamath River (and Iron Gate Reservoir), and thus cool quickly as the weather cools, providing thermal relief to the mainstem.

Dissolved oxygen sometimes falls to harmful levels below Iron Gate Dam at night during warm periods of the summer. This is caused by the high nutrient load from upstream sources causing increased algal growth in the warm water. The generally well-oxygenated tributary inflows can provide water quality refuge areas for coho salmon as they enter the mainstem Klamath River.

The combined effects of high temperatures, high nutrient concentrations, and low dissolved oxygen levels during the summer months can create extremely stressful conditions for coho salmon and other salmonids in the Lower Klamath River. High nutrient concentrations and associated increase in the abundance of algae and aquatic plants tend to lead to increased sedimentation and water temperatures, slower velocities, and lower dissolved oxygen. In June of 2000, temperatures and dissolved oxygen levels reached critical levels in the Klamath River and resulted in a large fish kill of juvenile salmonids (CDFG 2000a). No major fish kills were reported in the mainstem Klamath River during summer 2001. A major fish kill of adult salmonids occurred in the lower 36 miles of mainstem Klamath River during September, 2002. A minimum of 33,000 adult salmon died (CDFG 2003). Of the dead fish collected by CDFG downstream of the mouth of Blue Creek on September 27, 2002, 95.2 percent were fall Chinook salmon and 0.5 percent were coho salmon (CDFG 2003).

High nutrient concentrations in the Klamath River in large part come from the Upper Klamath basin where anthropogenic sources contribute significantly. Widespread grazing, agriculture, logging and conversion of wetland to agricultural land have increased nutrient loading. Most lakes in the Upper Klamath basin are shallow and water temperatures closely track air temperatures. Thus, flows originating from the headwater areas are naturally warm during the summer.

Fish Harvest

Commercial fishing for salmon in the Klamath River had major impacts on populations as early as 1900. Commercial and recreational ocean troll fisheries, tribal subsistence fisheries, and in-river recreational fisheries have impacted salmon including coho throughout the 20^{th} Century. Over-fishing was considered one of the greatest threats facing the Klamath River coho salmon populations in the past. However, these harvest rates probably would not have been as serious if spawning and rearing habitat was not so extensively reduced and degraded. Sport and commercial fishing restrictions ranging from severe curtailment to complete closure in recent years may be providing an increase in adult coho survival. The tribal harvest in the Klamath has been relatively small in the last five years and likely has not had a measurable effect on coho populations (NMFS 2001).

Hatchery Programs

The Klamath and Trinity Basin coho salmon runs are now composed largely of hatchery fish, although there may still be wild fish remaining in some tributaries. Because of the predominance of hatchery stocks in the Klamath River basin, stock transfers (use of spawn from coho salmon outside the Klamath River basin) in the

Trinity and Iron Gate Hatcheries may have had a substantial impact on natural populations in the basin. Artificial propagation can substantially affect the genetic integrity of natural salmon populations in several ways. First, stock transfers that result in interbreeding of hatchery and natural fish can lead to loss of fitness (survivability) in local populations and loss of diversity among populations (Weitkamp et al. 1995). Second, the hatchery salmon may change the mortality profile of the populations, leading to genetic change relative to wild populations that is not beneficial to the naturally reproducing fish. Third, hatchery fish may interfere with natural spawning and production by competing with natural fish for territory or mates. The presence of large numbers of hatchery juveniles or adults may also alter the selective regime faced by natural fish.

Coho Salmon Abundance in Klamath River Basin

Limited information exists regarding present coho salmon abundance in the Klamath River basin. Adult counts in a few Klamath River tributaries and juvenile trapping on the Klamath River mainstem and tributaries provide valuable information on presence of coho salmon in specific areas during key time periods, but less valuable for determining population status or trends (NMFS 2001). However, they do provide some indication of low abundance and the status of coho salmon populations in the Klamath River basin.

Adult Data

During the period 1991 and 2000, adult coho salmon counts using weir and video observations in the Shasta River ranged from 0 to 24 fish, with 1 or 0 fish counted during four of these years. Counting weirs in the Scott River indicated an average of 4 fish (range 0-24) during the period 1991 and 2000. One of those years accounted for approximately 65 percent of the total number of coho observed and zero coho were observed in four years. Coho salmon were observed in the Scott River during this period as early as September 21. In Bogus Creek, an average of 4 coho adults (range 0-10) were counted at the weir. These data emphasize the importance that one year's spawning success can have on the survival of these coho salmon stocks.

Coho salmon counts in the Trinity River are mostly of hatchery origin, and 100 percent marking of hatchery coho salmon has only recently occurred so estimates of naturally-produced coho are only available since the 1997 return year. The results of counting for the 1997-1998, 1998-1999, and 1999-2000 seasons yielded an estimated 198, 1,001, and 491 naturally produced adult coho salmon, respectively (CDFG 2000b). Coho salmon were first observed at the Trinity River weir during the week of September 10 during the 1999-2000 trapping season (CDFG 2000b).

Juvenile Data

Recent smolt data suggests that Klamath Basin coho salmon recruitment is very low. Juvenile traps, operated by USFWS on the Klamath River mainstem at Big Bar (RM 48), were used to estimate indices of smolt production. Based on counts from these traps between 1991 and 2000, the annual average number of wild coho salmon smolts was estimated at only 548 individuals (range 137-1,268)(USFWS 2000b). For the same period, an average output of 2,975 wild coho salmon smolts (range 565-5,084) was estimated for the Trinity River at Willow Creek, within the Trinity sub-basin (USFWS 2000b). The incomplete trapping record provides limited information in terms of temporal trends, but it still is a useful indicator of the extremely small size of coho salmon populations in the Klamath Basin.

The USFWS operates downstream juvenile migrant traps on the mainstem Klamath River at Big Bar (RM 48). The incomplete trapping record provides limited information in terms of abundance or trends, but does indicate the presence of coho at different life stages during certain times of the year (NMFS 2001). Indices of abundance are calculated from actual numbers trapped. In 2001, coho salmon smolts from trapping at Big Bar resulted in an actual total count of 23 fish between April 9 and July 22; 14 which were considered wild (USFWS 2001b). Trapping was discontinued after July 22 because of heavy algal loading in the traps.

A 1997 FWS report and 2001 mainstem trap data (CDFG unpublished data) show that young-of-the-year coho salmon are emerging from the Shasta and Scott rivers, where they probably were spawned, into the mainstem of the lower Klamath River between March and August. Considering the low numbers of coho salmon fry that have been reported from these sub-basins, it is unlikely that these fish were displaced downstream because of competitive interactions with other juveniles of their own species. Instead, the most likely explanation for their summer movement is that declining water quality and quantity in the lower-order tributaries force these young fish to seek refuge elsewhere. Thus, they end up in the river's mainstem earlier than in other river systems. This exploratory behavior and movement in search for adequate nursery habitat has been well documented, especially before the onset of winter (Sandercock 1991).

Stream Habitat Conditions

Anadromous salmonids in the Klamath River are restricted to the mainstem Klamath River and tributaries below Iron Gate Dam. Jenny Creek is located upstream of Iron Gate Dam and is not accessible to coho salmon. No passage facilities exist at Iron Gate or Copco dams, which are owned and operated by PacifiCorp.

Coho salmon still occur in the Klamath River and its tributaries (CH2M Hill 1985; Hassler et al. 1991). Between Seiad Valley and IGD, coho salmon populations are believed to occur in Bogus Creek, Shasta River, Humbug Creek, Empire Creek, Beaver Creek, Horse Creek, and Scott River (NMFS 1999). Between Orleans and Seiad Valley, coho salmon populations are believed to occur in Seiad Creek, Grider Creek, Thompson Creek, Indian Creek, Elk Creek, Clear Creek, Dillon Creek (suspected), and Salmon River (NMFS 1999). Finally, between Orleans and Klamath (mouth of the river), coho salmon populations are believed to occur in Camp Creek, Red Cap Creek, Trinity River, Turwar Creek, Blue Creek, Tectah Creek, and Pine Creek (NMFS 1999). It is estimated that Shasta River presently maintains approximately 38 miles of coho habitat, which is below predevelopment levels (INSE 1999). Available data suggests that existing coho salmon habitat in the Scott River now constitutes approximately 88 miles (INSE 1999).

Unscreened or ineffectively screened diversions are common in the Shasta and Scott Rivers resulting in substantial entrainment and fish stranding. Downstream migrants are also trapped in pools or side channels when stream flows drop sharply during early summer and soon die from high temperatures, lack of food, or predation. Some portions of streams often become entirely dewatered due to diversion. To date, CDFG has screened 30 diversions throughout the Scott River. Coho salmon juveniles are very susceptible to diversions because they need to spend at least one full summer in the stream.

4.3 Lost River and Shortnose Suckers

A great deal of environmental baseline information exists on the Lost River and shortnose suckers in the Klamath River basin. Portions of the information contained in this section were taken from the 2002 Biological Opinion on the 10-year (June 1, 2002, through March 31, 2012) Operation Plan for the Klamath Project, USFWS BO 1-10-02-F-121 (USFWS 2002). This information is included by reference into this BA.

Early records indicate Lost River and shortnose suckers were widespread and abundant within their range. The Klamath and Modoc Indians Spring relied on sucker runs at the beginning of the 20th century as a food source, and local settlers used them for both human consumption and livestock feed. Sucker runs were so numerous a cannery was established on the Lost River and several commercial operations processed enormous amounts of suckers into oil, dried fish, and other products (Andreasen 1975). A popular snag fishery existed on Sprague and Williamson Rivers during the 1960s and 1970s. Sucker populations likely numbered in the millions.

Nearly all Klamath basin streams and rivers have been degraded, some seriously, by the loss of riparian vegetation, geomorphic changes, introduction of return flows from agricultural drainage ditches and water pumped from drained wetlands, stream channelization, dams, and flow reductions from agricultural and hydroelectric diversions. Several water bodies in the Klamath basin fail to meet state water quality criteria. Wetland losses have been especially significant for suckers since wetlands provide habitat for larval and juvenile suckers and provide beneficial water quality functions.

The factors contributing to the decline of the suckers include habitat loss, degradation, and fragmentation; small or isolated adult populations (reproduction); isolation of existing populations by dams (passage); poor water quality leading to large fish die-offs and reduced fitness; lack of sufficient recruitment; entrainment into irrigation and hydropower irrigation canals; hybridization with other native Klamath sucker species; potential competition with and predation by non-native fishes; and overharvesting by sport and commercial fisheries.

Historically, both Lost River sucker and shortnose sucker occurred throughout the Upper Klamath basin, with the exception of the higher, cooler tributaries dominated by resident trout and the upper Williamson, which is isolated by the Williamson Canyon. At the time of listing, Lost River sucker and shortnose sucker were reported from Upper Klamath Lake, its tributaries, Lost River, Clear Lake Reservoir, the Klamath River, and the three larger Klamath River reservoirs (Copco, Iron Gate, and J.C. Boyle). The general range of Lost River sucker and shortnose sucker had been substantially reduced from its historic extent by the total loss of major populations in Lower Klamath Lake, including Sheepy Lake and Tule Lake (Federal Register 53:27130).

The current geographic ranges of the Lost River sucker and shortnose sucker have not changed substantially since they were listed and only two additional shortnose sucker and one Lost River sucker populations have been recognized since 1988. They all occur in isolated sections of the Lost River drainage, within the historical ranges of the species, and include an isolated population of shortnose sucker in Gerber Reservoir and a small population (limited to several hundred adults) of each species in Tule Lake.

The Klamath River reservoir population receives individuals carried downstream from upper reaches of the river, but they are isolated from the Upper Klamath basin by dams and show no evidence of self-sustaining reproduction (Desjardins and Markle 2000). (USFWS 2002)

4.3.1 Iron Gate Reservoir

Suckers may spawn successfully in tributaries to Iron Gate Reservoir as documented by the presence of sucker larvae in 1998 and 1999. However, because the species of sucker larvae can't be identified, it is not known which sucker species was successful. Sucker spawning may also occur in the Klamath River downstream from Copco 2 Reservoir in Iron Gate Reservoir.

Few or no sucker larvae survive in Iron Gate Reservoir either because adult populations are too small, producing too few larvae to survive normal early mortality rates, or because habitat conditions are unfavorable (Desjardins and Markle 2000).

Fish surveys were conducted in Iron Gate Reservoir from 1997 to 1999 (Desjardins and Markle 2000). A total of 22 adult shortnose suckers and 22 Klamath smallscale suckers (*Catostomus rimiculus*) were collected. Larger and older individuals dominated with little variation in size structure of those fish collected. Additionally, 42 and 1,135 unidentified sucker larvae were collected in 1998 and 1999, respectively. Larvae were small and only captured during early summer. No juvenile suckers and no Lost River suckers were collected during these surveys.

Predation pressure may be high in Iron Gate Reservoir because its fish community is dominated by exotic predators including yellow perch (*Perca flavescens*), brown bullheads (*Ameiurus nebulosus*), largemouth bass (*Micropterus salmoides*), white crappie (*Pomoxis annularis*), and green sunfish (*Lepomis cyanellus*). The percent of exotic predators in 1999 was 77 percent in Iron Gate Reservoir compared to 37 percent in J.C. Boyle Reservoir, and 66 percent in Copco Reservoir.

Water Quality in Iron Gate Reservoir

Iron Gate Reservoir water quality is a function of hydrology, operating conditions, inflow water quality, and meteorological conditions.

Reservoir residence times and water temperatures play a key role in reservoir water quality. Surface water temperature generally increases from January through July then gradually declines from August through December (Deas and Orlob 1999). Thermal stratification begins in March as air temperatures increase, strengthens through the summer and then breaks down with the onset in cooler weather from October or November.

Water quality conditions in Iron Gate Reservoir are generally poor from late spring to mid-fall in most years due to algae blooms, particularly blue-green algae

Aphanizomenon (Campbell 1999, PacifiCorp 2000). High pH conditions (> 9) that are stressful for fish are common in surface waters during summer. Dissolved oxygen levels generally remain adequate for fish in surface waters above the thermocline while dissolved oxygen levels below the thermocline are near zero at the bottom (Deas and Orlob 1999). Fish are likely restricted to shoreline areas and surface waters during the summer due to low dissolved oxygen concentrations. Because suckers are bottom oriented, low near bottom dissolved oxygen concentrations force them to occupy suboptimal habitat. This may lead to increased stress, slower growth, and potentially higher mortality. Water quality conditions are good during late-fall, winter, and spring when the reservoir is mixed and there is lower algal growth (PacifiCorp 2000).

The Iron Gate facility is operated for base load generation and for providing stable flows in the Klamath River downstream from the dam. It also provides required minimum flows downstream from the facility. (USFWS 2002)

Downstream river fluctuation caused by releases at Iron Gate Dam are limited to the lesser of a 3-inch-per-hour or 250 cfs per hour ramp rate as established in the FERC license. Iron Gate reservoir can fluctuate a maximum of about eight feet between normal minimum and full pool elevations. Average daily fluctuation is roughly 0.5 foot. There are no specific requirements established for reservoir fluctuations. (USFWS 2002)

4.3.2 Jenny Creek

Two high waterfalls (20 and 60 feet high) are about 2 miles upstream from the mouth of Jenny Creek completely blocking upstream passage. No information is available on sucker spawning or rearing in Jenny Creek.

Jenny Creek watershed upstream from the falls (RM 2) supports a number of endemic fish and macroinvertebrates (BLM 2000). A number of introduced fish are also supported, primarily in headwater reservoirs. Three endemic fish include: Jenny Creek sucker (*Catastomus rimiculus* ssp.), redband trout (*O. mykiss*), and Klamath speckled dace (*Rhinichthys osculus klamathensis*). The Draft Management Plan/Environmental Impact Statement for Cascade Siskiyou Ecological Emphasis Area, including Jenny Creek watershed, provides a review of natural resources and effects of management practices (BLM 2000).

Water Quality in Jenny Creek

Jenny Creek from the mouth to RM 17.8 is on Oregon's Final 2002 303(d) List for temperature during the summer (Oregon 2003). Jenny Creek water quality is assumed to be much better than Klamath River based on the presence of several water quality sensitive indicators including the Jenny Creek sucker, redband trout, and freshwater mollusks.

4.4 Northern Spotted Owl

Loss and fragmentation of suitable habitat is the primary threat to the northern spotted owl (Federal Register 55:26114, Federal Register 57:1796; Tuchmann 1996; Alford, et al. 2001). This is due primarily to timber harvest practices, particularly when even-aged (i.e., clearcutting) rather than mixed-aged techniques are used. At the time of listing, more than 90 percent of the timber harvest throughout the range of the spotted owl was accomplished using clearcutting methods that produced even-aged stands. In addition, timber management regimes at that time indicated it was most economically beneficial to harvest stands aged 60-90 years, the approximate age at which these stands are beginning to support spotted owls. This reduction in habitat forces spotted owls to crowd into areas that can support the species. If alternate suitable habitat does exist, it will often be forced over carrying capacity, reducing the viability of the spotted owls residing therein (Federal Register 55:26114).

Over 150 northern spotted owl breeding territories exist in forested lands throughout the Rogue River basin (ONHP 2000). However, northern spotted owls do not forage on fish or other aquatic species that would attract them to Project reservoirs, nor do they depend on habitat provided by Project facilities. Most of the breeding territories are above elevation 3500 feet in mature or old growth forest.

4.5 Bald Eagles

The historic distribution of bald eagles included most of the North American continent. A steep decline in reproduction from 1947 to 1970 is attributed to widespread use of organochloride pesticides (USFWS 1986). Habitat degradation, illegal harassment and disturbance, poisoning, and reduced food base also contributed to the decline. Bald eagle populations have increased steadily since listing under the ESA. The improvement is a direct result of bans on DDT and other persistent organochloride pesticides, habitat protection, and a growing public awareness of the bald eagles' plight.

The Project reservoirs are in the bald eagle California/Oregon Coast Recovery Zone (RZ 23) which includes 23 known breeding territories. Of these, 21 were occupied in 2002 and 14 (70 percent) were successful and fledged an average of 1.15 eaglets per occupied territory. In the five year period from 1998-2002, 56 percent of occupied territories have been successful and have produced an average of 0.89 eaglets per occupied territory. The Pacific Bald Eagle Recovery Plan goal is a 5-year average of 1.0 eaglet produced per occupied nest and a nesting success average of 65 percent. State-wide, 2002 saw 408 eaglets hatched in 401 breeding territories (1.06 eaglets/occupied territory, 66 percent overall breeding success). Table 4-15 provides a historical summary of bald eagle nesting success at water bodies in the action area.

Emigrant Lake

Emigrant Lake Park is open year round for day use and the campground is open from March through October with peak use from May through Labor Day (Reclamation 1995). The park provides recreational use including a park, campground, ball field, waterslide, boat ramps, and parking lots. There is a considerable amount of human activity in the summer months.

A former nest site approximately 2 miles southwest from Emigrant Lake between Hill and Neil Creeks had been observed since its 1993 discovery (Table 4-15). The nest tree was a live Ponderosa pine on privately owned timber land (Popp and Isaacs 1995). Despite seven consecutive annual attempts to raise young, the eagle pair at Emigrant was never able to successfully fledge an eaglet. The nest came down in 2000. The eagle pair built a new nest at nearby Slide Creek on BLM lands in 2001 and has successfully bred and flegded one chick in 2001 and one in 2002. This pair probably continues to fish at Emigrant Lake and pirate prey from the local ospreys.

A draft management plan for the defunct nest was written by Oregon Eagle Foundation in cooperation with Reclamation, BLM, USFS, and ODFW (Popp and Isaacs 1995). This nest site was unique because the nest was higher above its food source than any other bald eagle nest in Oregon (Isaacs 2001). The difference between the surface of the lake and the nest, an elevation of approximately 2500 feet, was likely to have been a significant factor in its lack of production (Wray 2001). Emigrant Lake eagle observations in 1994 and 1995 identified human disturbances that caused eagles to leave their perches especially during peak recreational use of the reservoir in June and July (Popp and Isaacs 1995) indicating that human presence may have also been a contributing factor in this nest's failure to produce young.

Hyatt Reservoir

The one known established breeding site on the east shore of Hyatt Reservoir has a long history of nesting data (Table 4-15). Twenty-seven chicks have fledged at Hyatt since 1971 when eagle monitoring began. Ten instances of failure to nest or breed have occurred in 32 years and the site remained vacant during the 1977 season. The last 5-year success rate is 80 percent and average young produced is 1.0 per occupied nest. Fish, the primary prey of eagles at this location, is often obtained by stealing from osprey that also forage at the reservoir (Kaiser 2001). The reservoir freezes over almost every year and wintering eagles are infrequently observed (Arnold 2001). The piscicide, rotenone, was applied to Hyatt Reservoir in fall 1989 to control a large population of brown bullhead in the reservoir but nest production was stable in following years.

The BLM refers to the recreational facilities around Hyatt Reservoir collectively as the Hyatt Reservoir Recreation Complex. These include two private resorts and two BLM campgrounds that open in April and close in October. The larger BLM campground, Main Campground, has 47 sites for RVs and tent camping, a group day-use area for up to 150 people, a softball field, volleyball court, playground, and two boat ramps and dock facilities. The smaller BLM campground, Wildcat Campground, has 14 sites and one boat ramp. The resorts offer boat rentals, restaurants, and boat ramps. The reservoir is stocked with rainbow trout for fishing. A 10-mph boat speed limit prevents water skiing or similar water activities. A segment of the Pacific Crest Trail winds around the reservoir from the southern shore and along the eastern shore and continues to Howard Prairie Lake.

Howard Prairie Lake

Howard Prairie Lake supports nest sites on its west, north, and south shores (Table 4-15). The west shore nest location fledged one chick annually from 1997 to 1998 and from 2000 to 2001, and two chicks in 1999. No chicks survived in 2002 despite breeding activity in the area of the western nest. The nest has averaged 1 young per year. The second nest site, north of the reservoir, has had sporadic success since the first recorded nesting in 1983; successfully fledging ten chicks in 17 years (0.59 young per year). In 1999 the northern nest came down and the pair has built a new nest on Doe Island which has produced 4 chicks in the 2 years since it was built. The third nest site, south of the reservoir, fledged 8 young in 12 years (0.67 young per year). Eight consecutive breeding seasons, from 1994-2001, either failed to produce offspring despite the presence of adult bald eagles or monitoring crews were not able to determine the reproductive status of the nest (Table 4-15). Then, in 2002, the nest pair fledged 2 eaglets. The reason for the failures and subsequent success remains

Table 4-15. Bald Eagle Nesting Success[1]

Year	Emigrant Lake	Hyatt Reservoir	Howard Prairie Lake		
			West	Doe Island	South
2002	X	1	0	2	2
2001	X	1	1	2	?
2000	X	2	1	X	?
1999	0	0	2	2	?
1998	0	1	1	0	0
1997	0	1	1	0	0
1996	0	0		1	0
1995	0	1		0	0
1994	0	0		0	0
1993	0	1		0	2
1992		1		1	2
1991		1		1	2
1990		1		2	0
1989		0		0	
1988		0		1	
1987		0		0	
1986		1		0	
1985		1		1	
1984		2		0	
1983		0		1	
1982		0			
1981		0			
1980		0			
1979		2			
1978		2			
1977		?			
1976		2			
1975		1			
1974		1			
1973		1			
1972		2			
1971		1			
Total	0	27	6	14	8
Average	0	0.87	1.0	0.74	0.80

1 chicks fledged per breeding territory per year
0: nesting site occupied, but failure to reproduce
?: no available data
X: nest no longer exists

unknown. The last 5-year success rate is 68 percent and average young is 1.01 per occupied breeding area. The reservoir usually remains unfrozen in the winter and over-wintering eagles have been observed (Arnold 2001).

Howard Prairie Lake receives heavy recreational use at the five Jackson County campgrounds and one private resort which surround the lake. Overall, the reservoir has approximately 600 campsites. One of the campgrounds is a designated horse camp, and all of the campgrounds have boat ramps. The reservoir is stocked with rainbow trout, making it a popular fishing location. Peak use at Howard Prairie Lake is from April, with the start of fishing season, through Labor Day.

4.6 Gentner's Fritillary

Gentner's fritillary is threatened by disturbance, alteration, and loss of habitat, and problems associated with small population sizes. Threats to the species include residential development, agricultural land conversion, logging, road construction, recreational activities, off-road vehicle use, bulb collection for gardens, and the small population size. (Federal Register 67:70452)

Habitat loss is associated with rapidly expanding residential construction for homes, roads, driveways; public projects such as schools and landfill expansion; and agricultural conversion, and is the main threat to this species. Timber harvest and recreational activities disturb habitat. Extremely small population sizes leave the species vulnerable to catastrophic events. Ongoing development accounts for 13 percent of habitat losses. Future development may eliminate another 29 percent of habitat. (Federal Register 64:69195)

Invasive weeds and successional encroachment by trees and brush is altering habitat. Records indicate natural fires occurred every 12-15 years and these frequent, low-intensity fires maintained the open canopy normally found within oak woodlands. The transformation from a grassy understory to a shrub understory, along with a dense, closed canopy, is excluding Gentner's fritillary (Federal Register 64:69195). The Nature Conservancy designated the oak woodlands as an endangered habitat and the mixed hardwood and coniferous forests as threatened habitat due to their respective dominant tree species.

Past development extirpated plants from 8 of the 53 originally identified locations. For example, about one-half of a population was bulldozed in 1988 as a result of road construction and dump expansion at Jackson County Landfill. One-fourth of another population occurring at Pelton Road was destroyed in 1990 due to a road-widening project (Federal Register 64:69195).

Each of the three habitats is also threatened due to fire suppression. For example, oak woodlands within this area are becoming more thickly wooded and less grassy due to fire suppression. Residential development also makes prescribed burning difficult. Records indicate natural fires occurred every 12-15 years and these frequent, low-intensity fires maintained the open canopy normally found within oak woodlands. The transformation from a grassy understory to a shrub understory, along with a dense, closed canopy, is excluding Gentner's fritillary (Federal Register 64:69195).

4.7 Large-Flowered Woolly Meadowfoam

Habitat loss and, to a lesser degree, certain livestock grazing practices, off-road vehicle use, and competition with nonnative plants, have decreased the acreage occupied by large-flowered meadowfoam (Federal Register 65:30941).

The large-flowered woolly meadowfoam was observed on five vernal pool systems during 2000-2002 mapping surveys. The distribution of the species has been found to vary from year to year at each location. Mapped habitat for large-flowered woolly meadowfoam decreased from 80 hectares (198 acres) in 1998 to 47 hectares (116 acres) as reported in the 2002 Oregon Natural Heritage Information Center (ONHIC) database. (Federal Register 67:68004) The Nature Conservancy (TNC) manages known sites within the Agate Desert Preserve for protection of the species.

Community development pressure brought about much of this habitat loss. Human population growth in Jackson County is occurring at an extremely rapid rate. Much of this growth is taking place near Medford and White City in the heart of Agate Desert along with an increase in residential, commercial, and industrial development and subsequent loss of vernal pool habitat. Jackson County and the city of Medford development projects impacted much of the original Agate Desert vernal pool habitat occupied by this plant. Other projects, including past game habitat development at Denman Wildlife Area, have eliminated large tracts of habitat (Federal Register 65:30941).

The only large-flowered woolly meadowfoam habitat currently protected from development is on the Agate Desert and Whetstone Savanna Preserves managed by The Nature Conservancy. Approximately 41.2 acres of habitat exists on the preserves and supports the largest populations of the species. However, development plans have been made for lands immediately surrounding the preserves.

Although habitat loss is the primary threat to large-flowered woolly meadowfoam, water projects may have an adverse effect on this species as well. Diversion and blockage of surface runoff feeding the pools can result in premature dry-down before these plants are able to produce seeds prior to going dormant. Supplemental water from outside the natural watershed into vernal pools can change the habitat into a marsh-dominated or a permanent aquatic community where marsh plants may outcompete large-flowered woolly meadowfoam (Borgias 2001).

Physical barriers such as roads and canals may unsuitably deepen a vernal pool upstream from a barrier. Surface runoff can be altered by trenching and other activities that change amounts, patterns, and direction of surface runoff to ephemeral swales and pools.

Invasion of nonnative annual plants in Agate Desert has altered native perennial plant communities (Federal Register 65:30941) where large-flowered woolly meadowfoam grows. Native bunch grasses on mounds between vernal pools have been replaced by introduced European grasses such as brome grass (*Bromus mollis*), medusahead (*Taeniatherum caput-medusae*), dogtail (*Cynosurus echinatus*), and bluegrass (*Poa bulbosa*). Medusahead competes with large-flowered woolly meadowfoam on seasonally wet mounds between the pools. Seeds of large-flowered woolly meadowfoam are not able to germinate under dense thatch produced by these introduced annual species (Federal Register 65:30941).

4.8 Cook's Lomatium

Reasons for decline include industrial, commercial, and residential development, public utility construction and development of utility corridors, land conversion for agricultural uses, weed invasion, roadside spraying, and mowing.

The historical range of Cook's lomatium may have encompassed over 130 square kilometers (50 square miles) in the Agate Desert. The vernal pool habitat upon which this species depends has almost been completely eliminated in Jackson County, Oregon. Mapped habitat totaled 54 hectares (133 acres) in 1998 (Federal Register 67:68004). However, the 2002 ONHIC database showed that the area of occupied habitat had decreased to an estimated 28 hectares (69 acres) (Federal Register 67:68004). The only Cook's lomatium habitat currently protected from development is on the Agate Desert and Whetstone Savanna Preserves managed by The Nature

Conservancy. Approximately 17 acres of habitat exists on the preserves and supports the largest populations of the species.

Community development pressure brought about much of this habitat loss. Human population growth in Jackson County is occurring at an extremely rapid rate. Much of this growth is taking place near Medford and White City in the heart of the Agate Desert with an increase in residential, commercial, and industrial development and subsequent loss of vernal pool habitat. Several of the Jackson County and city of Medford development projects destroyed vernal pool habitat and eliminated populations of Cook's lomatium.

Invasion of nonnative annual plants in Agate Desert has altered native perennial plant communities (Federal Register 65:30941) where Lomatium cookii grows. Native bunch grasses on mounds between vernal pools have been replaced by introduced European grasses such as brome grass (*Bromus mollis*), medusahead (*Taeniatherum caput-medusae*), dogtail (*Cynosurus echinatus*), and bluegrass (*Poa bulbosa*). Medusahead competes with Cook's lomatium on seasonally wet mounds between the pools. The seeds of Cook's lomatium are not able to germinate under the dense thatch produced by these introduced annual species.

Although habitat loss is the primary threat to Cook's lomatium, water projects may have an adverse effect on this species as well. Diversion or blockage of watershed runoff feeding the pools can result in premature dry-down before these plants are able to produce seeds prior to going dormant. Supplemental water from outside the natural watershed into vernal pools can change the habitat into a marsh-dominated or a permanent aquatic community where marsh plants may out compete Cook's lomatium (Borgias 2001).

Physical barriers such as roads and canals may unsuitably deepen a vernal pool upstream of a barrier. Surface runoff can be altered by trenching and other activities that change amounts, patterns, and direction of runoff to ephemeral swales and pools.

4.9 Vernal Pool Fairy Shrimp

The vernal pool fairy shrimp is an obligate vernal pool species relying on the presence of functioning vernal pools for survival. Although habitat loss is the principal danger to vernal pool fairy shrimp, water supply conditions can be a disturbance factor that may affect a substantial portion of the populations. The timing, frequency, and length of inundation of the vernal pool habitat are critical to survival of vernal pool fairy shrimp; any substantial hydrologic change in these factors adversely affects this species (Federal Register 59:48136).

Diversion (or blockage) of surface runoff feeding the pools can result in premature dry-down before the life cycle of these animals is completed. Supplemental water from outside the natural watershed into vernal pools can change the habitat into a marsh-dominated or a permanent aquatic community that is unsuitable for the vernal pool fairy shrimp.

Physical barriers such as roads and canals unsuitably deepen a vernal pool upstream from a barrier and can isolate a fairy shrimp population from a portion of its aquatic habitat. Surface runoff is altered by disturbance from trenching and other activities that change amounts, patterns, and direction of surface runoff to ephemeral drainages. Introduction of water during summer can disrupt the life cycles of vernal pool crustaceans by subjecting them to greater levels of predation by animals such as bullfrogs and predatory fish that require more permanent sources of water.

Human activities, such as urban development and conversion of land to agricultural use, eliminated much of the original vernal pool habitat and threaten remaining habitat (Federal Register 59:48136, Belk 1998, TNC 2000). About 197 acres are protected in The Nature Conservancy's Agate Desert (53 acres) and Whetstone Savannah Preserves (144 acres) (TNC 2000).

Originally, the vernal pools covered about 21,000 acres. The Nature Conservancy indicates only about 7,700 acres of the original vernal pool habitat remains in the area and only about 4,750 acres are in the highest integrity class having intact topography/ hydrology and altered vegetation. Only about 2,100 acres have well distributed and abundant vernal pools (Borgias and Patterson 1999).

Vernal pool crustaceans are very sensitive to the water chemistry of their habitats. Pools where fairy shrimp have been found have low total dissolved solids, low conductivity, low alkalinity, and low chloride concentrations (Federal Register 59:48136). Contamination of vernal pools from adjacent areas may injure or kill vernal pool crustaceans.

Certain pesticides are registered by EPA for use on rangelands and these may be sprayed directly on vernal pools. Mosquito abatement activities sometimes also include direct application of pesticides to pools including vernal pools. Some compounds do not degrade in a season, resulting in long-term accumulation (USFWS 2001c, USFWS 2000c). Fertilizer runoff may lead to eutrophication of vernal pools which can kill fairy shrimp by reducing the concentration of dissolved oxygen (Rogers 1998).

Plowing, grading, maintenance of canal roads, and other ground-disturbing activities near vernal pools can result in erosion/siltation problems within the pool the following wet season (Borgias 2001). Vernal pool fairy shrimp breath through lobes similar to gills. Fairy shrimp living in pools with a high amount of siltation may suffocate.